

On the Sexual Generation of Chermes abietis, Linn.

By Dr. F. BLOCHMANN.

I was led by the preparation of my lecture "Ueber ausgewählte Kapitel aus der Fortpflanzungs- und Entwicklungsgeschichte der Thiere" to attend in more detail to the cyclical development of the Aphides, and in this way I became aware of many still existing gaps in our knowledge. One such hiatus is to be found in the history of the reproduction of the genus *Chermes*, seeing that, notwithstanding the efforts of various distinguished observers, it was still undecided whether a sexual generation does or does not occur in its cycle of development. As the galls of *Chermes* are very abundant at many places here in Heidelberg, and especially on the so-called "Himmelsleiter," I took occasion during my walks to observe their development, in order to detect the sexual animals, the existence of which I fully expected to find from the great similarity of the course of development in *Chermes* and *Phylloxera*. In this I soon succeeded, and I would not omit giving a short communication here, especially because at the moment I am not in a position to furnish a detailed description with figures.

For the most detailed observations upon the life-history of the Bark-lice we are indebted chiefly to Ratzeburg* and Leuckart†. What is known from them is as follows:—In the autumn we find at the bases of buds of the fir small wingless animals covered with grey wool, which have buried their long proboscis deeply in the tissues, and in this position live through the winter. In the spring they grow considerably, with several changes of skin, the sexual organs especially becoming developed. The investigation of the latter shows that the animals are all *unfertilized* females. They now begin to lay a great number (up to about 200) of pedunculated eggs, which remain lying under the mother, enveloped in dense white wool. These soon become developed into female larvæ, which crawl between the leaves of the expanding bud. These are already deformed at the base of the bud by the sucking of the mother, and become still more so now by the united efforts of the brood, so that the well-known pineapple-like galls are produced. I may state here that of the two species, which are usually distinguished by the formation of their galls, the one which makes the smaller galls (*Chermes coccineus*, Ratz. = *C. strobilobius*, Kalt.) has served for my investigations.

In the galls the young animals increase in size, with several changes of skin, and develop wing-sheaths. At the beginning or middle of June the different chambers of the gall open, the nymphs crawl out upon the leaves of the nearest twigs, and then change their skin for the last time. After this moult they appear as winged insects, which, in fine weather quit the twig and settle themselves

* Die Forstinsekten, Bd. iii. pp. 195–205 (1844).

† "Die Fortpflanzung der Rindenläuse," in Arch. für Naturg. 1859, pp. 208–231.

here and there, usually not far from the gall out of which they crept forth. Anatomical examination shows that these animals also are all females, but that they differ in the structure of the ovary, by a much smaller number of egg-tubes, from the hibernating generation, which remained wingless. Ratzeburg believed that he observed a few males among these winged animals; but this was certainly due to an error, as, indeed, Leuckart has remarked. (Nevertheless O. Taschenberg still reproduces Ratzeburg's figure with the erroneous description—see 'Die Verwandlungen der Thiere' (1882), p. 224.)

These winged females settle themselves almost exclusively on the underside of older leaves, cover themselves again with a light woolly secretion, and lay a small number (I usually observed 8–12) of eggs, which, in dying, they cover with their roof-like wings. From these, consequently also unfertilized eggs, small yellowish creatures are developed, which, according to the opinions hitherto prevalent, should become developed into the wingless female generation, hibernating at the base of the buds. This course of development was regarded as certain by Leuckart in his memoir above cited; while subsequently*, from the analogy of the conditions of reproduction in the true Aphides, he regarded the existence of a sexual generation as possible, especially as Claus had informed him that he had once examined male fir-lice.

The supposition that the progeny of the winged females was the hibernating generation producing the galls in spring (which, however, no one had directly traced) was erroneous, for, in point of fact, their descendants are the *sexual animals* †. The newly-hatched animals remain for some time under the body of their mother, where they moult once; then they disperse themselves and creep briskly about on the bark of the twigs. Examination with the lens shows a difference among them. As already stated, they are in general of a yellowish colour. Some, however, strike one by the brownish extremity of the abdomen and also by their greater activity. These are the *males*. Anatomical examination shows in them two testes of considerable size, with mature and rather large spermatozoa, and a rather long penis beset with short hooklets. In the more sluggish females the end of the abdomen is not of darker colour. The sexual organs, as in the sexual generation of *Phylloxera*, consist of a *single egg-tube*, which, in the specimens examined, contains a *single large ovum*, which being not yet furnished with a chorion and vitelline membrane, is consequently not quite mature. On the oviduct are seated two lubricating glands and a large *receptaculum seminis*, which I have always found tightly packed with spermatozoa. It is further remarkable that both sexes possess

* "Die Fortpflanzung der Blatt- und Rindenläuse," in Blomeyer, A., Mitth. der landw. Inst. d. Univ. Leipzig, Heft i. (1875) p. 136.

† Whether the eggs deposited by the winged animals are to be recognized, as in *Phylloxera*, by their size as male and female I cannot say, as I have omitted attending specially to this point.

a well-developed proboscis and intestine, and therefore are certainly fitted for the reception of food.

While the males run briskly about in all directions upon the twigs, the females wander slowly but uninterruptedly downwards, that is towards the trunk. Of course, during this progress they are met with by the rambling males, and I had frequent opportunities of observing them *in copulá*. The fertilized females then crawl away, and thus it happens that one usually finds many more males than females. The latter creep upon the somewhat thicker branches into the fissures of the bark, and especially under the appendages at the base of the leaves, the so-called "Stollen," and here deposit their eggs. The females are easily found here, living or dead, along with the eggs. The latter are about 0·5 millim. in length and 0·22 millim. in thickness, enveloped in a little whitish wool. Usually two or three eggs lie together, and I regard it as not impossible that they are deposited by *one* female, as the latter might no doubt take nourishment, and so, after depositing the first egg, bring a second or even a third to maturity. I could detect the dead females and their eggs not only upon the twigs but also under scales of bark on the trunk itself. However, the firs on which I made these observations are still young trees, about 5–6 metres in height.

I observed the flying parthenogenetic females on the 19th of June. As many galls were then emptied, males and females were already present. I found the fertilized eggs deposited under the bark on the 2nd of July, and in all that came under observation the blastoderm was already developed. In this condition they remained until now (July 23*) according to observations made concurrently upon twigs in the open and preserved in glasses in the house. We may assume with certainty that from these eggs proceeds the wingless hybernating generation which we find in October at the bottom of the buds.

Hence we now perfectly know the developmental cycle of *Chermes*. It may be summarized as follows:—

1. A hybernating, wingless, parthenogenetic generation ;
2. A winged parthenogenetic generation ;
3. A generation of male and female wingless animals, from the fecundated eggs of which the first generation is again produced.

The whole course of development thus closely approaches that of *Phylloxera*, the only difference being that in *Chermes* the wingless females proceeding from the fecundated eggs directly produce the winged generation, while in *Phylloxera* a greater number of wingless generations intervenes between them.—*Biologisches Centralblatt*, September 15, 1887, Band vii. pp. 417–420.

* The eggs remained in the same stage of development until August 14 (when the proof was corrected).